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ABSTRACT

Information about the diploma examinations in Mathematics 30, Biology 30, Chemistry 30, and Physics 30 that will be administered during January, June, and August 1987, is provided in this bulletin. Topics explained include: (1) general format of the examinations (stating the content, emphasis, and time allotments for the examinations); (2) examinations schedule (listing the calendar dates and times for the specific examinations); (3) preparation of the examinations (describing the review process); (4) scoring of the examinations (specifying the required qualifications of the markers); and (5) descriptions of the mathematics, biology, chemistry, and physics examinations (explaining the content, blueprint, and distribution of questions by percentage for each of the examinations). Appendices present guidelines for significant digits, manipulations of data, rounding numbers and an explanation of cognitive levels. (ML)

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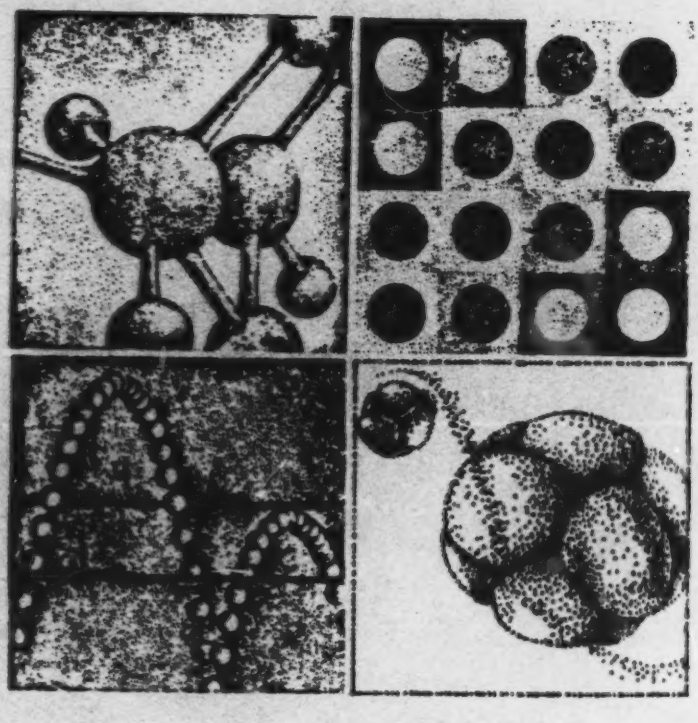
Grade 12 Diploma Examinations Program

Mathematics & Sciences



1986-87 School Year

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INTRODUCTION

Purpose of the Bulletin

The purpose of this bulletin is to provide information to teachers and students about the diploma examinations in Mathematics 30, Biology 30, Chemistry 30, and Physics 30 that will be administered during January, June, and August 1987. The bulletin explains the design of the examinations and how they will be marked.

Teachers are encouraged to inform their students of the content of the bulletin. In addition, students should have the opportunity to acquaint themselves with the nature and complexity of questions that appeared on previously administered mathematics and sciences diploma examinations.

Teachers and students should also refer to the curriculum specifications for each subject. These publications describe the specific content and objectives from which the test questions for the diploma examinations are developed. Teachers may also wish to refer to the bulletin entitled *General Information*, which provides administrative information about the diploma examination. The publication will be distributed to all senior high school administrators.

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General Format of Examinations

The time allotted for the diploma examinations in the mathematics and sciences subjects is two and one-half hours. The examinations consist of both multiple-choice questions (worth 80% of the total examination mark) and written-response questions (worth 20% of the total examination mark).

In the written-response portion of each examination, the marks assigned to each question are shown in the margin beside the question. Students are expected to communicate their answers clearly, to identify the steps in a solution, and to use annotated sketches or diagrams where appropriate. Guidelines for the use of significant digits required in the Chemistry 30 and Physics 30 examinations are listed in Appendix A. These guidelines are based on those prepared by the Canadian Standards Association.

Each examination is designed to reflect that subject's core concepts as outlined in the *Program of Studies for Senior High Schools*.

To the extent that pencil-and-paper testing permits, the Biology 30, Chemistry 30, and Physics 30 diploma examinations assess the student's ability to apply the scientific process skills of predicting, hypothesizing, controlling variables, classifying, interpreting data, observing, inferring, designing experiments, and defining in operational terms.

Understandably, the experience gained by hands-on activity is difficult to measure outside a laboratory situation and, therefore, should also be included in the teacher's evaluation of student performance.

The attitudinal and psychomotor components of the programs are not included in the diploma examinations.

Examinations Schedule

Dates for the administration of the 1987 mathematics and sciences diploma examinations are as follows:

January 27, 1987:	Chemistry 30	1:00 - 3:30 p.m.
January 28, 1987:	Physics 30	1:00 - 3:30 p.m.
January 29, 1987:	Mathematics 30	9:00 - 11:30 a.m.
	Biology 30	1:00 - 3:30 p.m.
June 22, 1987:	Chemistry 30	1:00 - 3:30 p.m.
June 23, 1987:	Physics 30	1:00 - 3:30 p.m.
June 24, 1987:	Mathematics 30	9:00 - 11:30 a.m.
June 25, 1987:	Biology 30	9:00 - 11:30 a.m.
August 11, 1987:	Chemistry 30	1:00 - 3:30 p.m.
August 12, 1987:	Biology 30	9:00 - 11:30 a.m.
	Mathematics 30	1:00 - 3:30 p.m.
August 13, 1987:	Physics 30	9:00 - 11:30 a.m.

Students must bring HB pencils and erasers, and they may bring approved calculators. Students should also bring rulers and protractors. No other aids will be permitted in the examination room without the permission of the Director of the Student Evaluation Branch.

Preparation of the Examinations

Teacher-written questions of the type that will appear on the diploma examinations are field-tested in high schools across the province. Test development specialists, in conjunction with teachers, build the examinations from suitable questions. Before the examinations are administered, they are reviewed by Diploma Examination Review Committees, which consist of representatives from the Conference of Alberta School Superintendents, the Alberta Teachers' Association, the Public Colleges of Alberta, the Universities Co-ordinating Council, and Alberta Education.

Scoring of the Examinations

The multiple-choice portion of each examination will be machine scored.

The written-response questions will be marked by teachers who have been recommended by their superintendents and appointed by the Student Evaluation Branch.

To be eligible to mark, a teacher must have taught the course for two or more years, be currently teaching the course, and have a valid Alberta Permanent Professional Teaching Certificate. Teachers who wish to be recommended as markers should contact their superintendents as soon as possible.

Following each administration of the 1987 diploma examinations, the written-response sections will be marked in Edmonton during February, July, and August.

Markers will review a suggested marking key, discuss allowable variations, and make necessary changes to the key. While consistency in marking will be closely monitored, allowances will be made for unique and creative solutions.

MATHEMATICS 30

Content

Each Mathematics 30 diploma examination is designed to reflect the common-core and independent-core concepts that are outlined in the *Program of Studies for Senior High Schools*.

Each concept on the Mathematics 30 diploma examination is emphasized as follows:

Concept	Emphasis in Per Cent of the Total Examination Mark
Trigonometry	25
Quadratic Relations	22
Sequences, Series, and Limits	19
Statistics	15
Logarithms	9
Polynomial Functions	10
	100%

Blueprint for the Examination

Fifty-two marks are allotted to the multiple-choice questions and 13 marks are allotted to the written-response questions on the Mathematics 30 diploma examination.

MATHEMATICS 30
Distribution of Questions by Percentage of Total Mark

CONCEPT \ COGNITIVE[1] LEVEL	KNOWLEDGE COMPUTATION	COMPREHENSION	APPLICATION	HIGHER MENTAL ACTIVITIES	TOTAL
Trigonometry	2	10	10	3	25
Quadratic Relations	2	8	10	2	22
Sequences, Series, and Limits	2	6	9	2	19
Statistics	2	5	7	1	15
Logarithms	1	3	4	1	9
Polynomial Functions	1	3	5	1	10
Total	10	35	45	10	100

[1] An explanation of cognitive levels is given in Appendix B.

BIOLOGY 30

Content

Each Biology 30 diploma examination is designed to reflect the Biology 30 core concepts that are outlined in the *Program of Studies for Senior High Schools*.

Each concept on the Biology 30 diploma examination is emphasized as follows:

Concept	Emphasis in Per Cent of the Total Examination Mark
Cellular processes are fundamental to life	9
Homeostatic mechanisms regulate the body and its systems	4
Humans must take in and process the required nutrients for absorption	16
Body fluids distribute essential nutrients to, and carry wastes away from, tissues	15
Breathing precedes gas exchange and transport	7
Energy is released by the oxidation of organic compounds	5
The kidney provides homeostatic control over body fluids	10
Regulation of the internal environment requires co-ordination between the nervous and hormonal systems	20
Voluntary movement and body support are the result of skeletal muscles and the skeletons to which they are attached	4
Humans are capable of reproducing	10
	100%

Blueprint for the Examination

Eighty marks are allotted to the multiple-choice questions and 20 marks are allotted to the written-response questions on the Biology 30 diploma examination.

BIOLOGY 30
Distribution of Questions by Percentage of Total Mark

CONCEPT[1] / COGNITIVE LEVEL[2]	KNOWLEDGE	COMPREHENSION AND APPLICATION	HIGHER MENTAL ACTIVITIES	TOTAL
Cellular Processes	3	5	1	9
Homeostatic Mechanisms	1	2	1	4
Nutrition and Digestion	6	8	2	16
Body Fluids	5	8	2	15
Breathing, Gas Exchange and Transport	3	3	1	7
Energy Release	2	2	1	5
The Kidney	4	5	1	10
Regulation of the Internal Environment	7	10	3	20
Voluntary Movement and Body Support	1	2	1	4
Human Reproduction	3	5	2	10
TOTAL	35	50	15	100

[1]Concept descriptions have been shortened in this table.

[2]Questions that require knowledge and skill in the application of scientific processes are distributed throughout the examination but are not associated with specific topics or cognitive levels. An explanation of each cognitive level is given in Appendix B.

Biology 30 Terminology

Terms from the following list may appear written in full or in abbreviated or symbolic form on the Biology 30 diploma examinations.

ADH	antidiuretic hormone
ADP	adenosine diphosphate
AMP	adenosine monophosphate
ATP	adenosine triphosphate
AV	atrioventricular
Ca^{2+}	calcium ion
Cl^{-}	chloride ion
CO_2	carbon dioxide
DNA	deoxyribonucleic acid
ECF	extracellular fluid
ER	endoplasmic reticulum
FSH	follicle stimulating hormone
GH	growth hormone
H^{+}	hydrogen ion
Hb	hemoglobin
HCl	hydrochloric acid
HCO_3^{-}	bicarbonate ion
H_2O	water
ICSH	interstitial cell stimulating hormone
LH	luteinizing hormone
NaCl	sodium chloride
Na^{+}	sodium ion
N_2	nitrogen gas
O_2	oxygen gas
pH	acidity of a solution
RNA	ribonucleic acid
SA	sinoatrial
TSH	thyroid stimulating hormone
[ ]	denotes concentration in moles per litre

Students are expected to know the symbolic form of any of the elements commonly used in the study of Biology 30.

CHEMISTRY 30

Content

Each Chemistry 30 diploma examination is designed to reflect the Chemistry 30 core concepts that are outlined in the *Program of Studies for Senior High Schools*.

Each concept on the Chemistry 30 diploma examination is emphasized as follows:

Concept	Emphasis in Per Cent of the Total Examination Mark
Chemical Energetics	32
Acids and Bases	34
Oxidation-Reduction	34
	100%

The prescribed course references present varying approaches to certain concepts in chemistry. Because of these discrepancies, the Student Evaluation Branch uses the following guidelines.

a. Chemical Energetics

Heat of reaction (ΔH) can be calculated from heats of formation or by the addition of equations that include heat terms. Both methods of calculating ΔH may be tested.

The Student Evaluation Branch uses the symbols E_k and E_p for kinetic and potential energy respectively.[1]

b. Acids and Bases

This concept includes polyprotic species.

The concepts of K_a and % reaction can serve the same function in many acid-base calculations. Since both values are given for the acids in the *Chemistry Data Booklet*, the student may use either method of calculation to answer acid-base questions.

c. Oxidation-Reduction

Oxidation numbers and half-reactions can serve to balance redox equations. Both methods may be tested.

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[1]These symbols are recommended by the Canadian Standards Association.

Blueprint for the Examination

Fifty-six marks are allotted to the multiple-choice questions and 14 marks are allotted to the written-response questions on each Chemistry 30 diploma examination.

CHEMISTRY 30
Distribution of Questions by Percentage of Total Mark

CONCEPT[1] / COGNITIVE LEVEL[2]	KNOWLEDGE	COMPREHENSION AND APPLICATION	HIGHER MENTAL ACTIVITIES	TOTAL
Chemical Energetics	11	16	5	32
Acids and Bases	12	17	5	34
Oxidation-Reduction	12	17	5	34
TOTAL	35	50	15	100

[1] Concept descriptions have been shortened on this table.

[2] Questions that require knowledge and skill in the application of scientific processes are distributed throughout the examination but are not associated with specific topics or cognitive levels. An explanation of cognitive levels is given in Appendix B.

PHYSICS 30

Content

Each Physics 30 diploma examination is designed to reflect the Physics 30 core concepts that are outlined in the *Program of Studies for Senior High Schools*.

Each concept on the Physics 30 diploma examination is emphasized as follows:

Concept	Emphasis in Per Cent of the Total Examination Mark
Nature and Behavior of Light	23
Electric and Magnetic Fields	27
Electromagnetic Radiation	15
Structure of Matter	20
Modern Physical Theories	15
	100%

The prescribed course references present different approaches to the measurement of wavelengths in the visible region of the electromagnetic spectrum. Because of these discrepancies, the Student Evaluation Branch uses the following guidelines.

a. Double-Slit Method

The formula $\lambda = dx/nl$ can be used for calculations of wavelengths, and students may be tested on this.

b. Diffraction Grating Method

The formula $\lambda = (d \sin \theta)/n$ can be used to calculate angles directly. The formula $\lambda = dx/nl$, together with appropriate use of trigonometry, can provide an answer that is a good approximation for small angles of diffraction. Multiple-choice examination questions are keyed to $\lambda = (d \sin \theta)/n$, but students who use $\lambda = dx/nl$ will not be penalized. Written-response questions will have scoring guides that allow for the use of either formula.

Blueprint for the Examination

Fifty-six marks are allotted to the multiple-choice questions and 14 marks are allotted to the written-response questions on the Physics 30 diploma examination.

PHYSICS 30
Distribution of Questions by Percentage of Total Mark

CONCEPT[1] / COGNITIVE LEVEL[2]	KNOWLEDGE	COMPREHENSION AND APPLICATION	HIGHER MENTAL ACTIVITIES	TOTAL
Nature and Behavior of Light	8	11	4	23
Electric and Magnetic Fields	10	13	4	27
Electromagnetic Radiation	6	7	2	15
Structure of Matter	6	11	3	20
Modern Physical Theories	5	8	2	15
TOTAL	35	50	15	100

[1] Concept descriptions have been shortened in this table.

[2] Questions that require knowledge and skill in the application of scientific processes are distributed throughout the examination but are not associated with specific topics or cognitive levels. An explanation of cognitive levels is given in Appendix B.

APPENDIX A: GUIDELINES FOR SIGNIFICANT DIGITS, MANIPULATION OF DATA, AND ROUNDING

The guidelines are based on those recommended by the Canadian Standards Association.

Significant Digits

1. Regardless of decimal position, any of the digits 1-9 is a significant digit, and 0 may be significant.

   e.g., 147 0.147 0.001 47 1.47×10^3 all have 3 significant digits

2. Leading zeros are not significant.

   e.g., 027 and 0.035 have 2 significant digits

3. Trailing zeros to the right of the decimal are significant.

   e.g., 0.127 00 and 20.000 have 5 significant digits

4. Zeros to the right of a whole number are ambiguous.

   e.g., 200

   If the number is an exact count, it is considered to be perfectly precise. Otherwise, it should be put into scientific notation.

   e.g., 2×10^2 has 1 significant digit
   2.0×10^2 has 2 significant digits
   2.00×10^2 has 3 significant digits

Manipulation of Data

1. When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise of the numbers used in the computation.

   e.g., 38.5 (least precise)
   0.123
   19.50
   58.123

   The answer should be rounded to 58.1.

2. When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity that has the fewest significant digits.

   e.g., 36.3 cm x 451.91 cm = 16 404.333 cm^2

   The answer should be rounded to 1.64×10^4 cm^2.

Rounding

1. When the first digit to be dropped is less than or equal to 4, the last digit retained should not be changed.

   e.g., 7.849 rounded to 2 digits is 7.8

2. When the first digit to be dropped is greater than or equal to 6, the last digit retained should be raised by one.

   e.g., 5.262 rounded to 2 digits is 5.3

3. When the first digit to be dropped is 5 or 5 followed by zeros, the last digit retained should be raised by one if it is odd and left unchanged if it is even.

   e.g., 3.65 rounded to 2 digits is 3.6
   3.7500 rounded to 2 digits is 3.8

   or

   When the first digit to be dropped is 5 or 5 followed by zeros, the last digit retained should be raised by one.

   e.g., 3.65 rounded to 2 digits is 3.7
   3.7500 rounded to 2 digits is 3.8

   Note: The Student Evaluation Branch accepts both of the conventions described above.

4. When the first digit to be dropped is 5 followed by digits other than zeros, the last digit retained should be raised by one.

   e.g., 2.148 501 rounded to 4 digits is 2.149
   2.135 22 rounded to 3 digits is 2.14

APPENDIX B: EXPLANATION OF COGNITIVE LEVELS

1. Knowledge

   Knowledge is defined as including those behaviors and test situations that emphasize the remembrance, either by recognition or recall, of ideas, material, or phenomena. This level comprises knowledge of terminology, specific facts (dates, events, persons, etc.), conventions, classifications and categories, methods of inquiry, principles and generalizations, and theories and structures.

2. Comprehension and Application

   Application requires that the student apply an appropriate abstraction (theory, principle, idea, method) to a new situation.

   Comprehension refers to responses that demonstrate understanding of the literal message contained in a communication. This means that the student is able to translate, interpret, or extrapolate. Translation refers to the ability to put a communication into another language. Interpretation involves the reordering of ideas (inferences, generalizations, or summaries). Extrapolation is the ability to make estimates or predictions based on an understanding of trends or tendencies.

3. Higher Mental Activities

   Analysis, synthesis, and evaluation are included in the category of higher mental activities. Analysis comprises the ability to recognize unstated assumptions, to distinguish facts from hypotheses, to distinguish a conclusion from statements that support it, to recognize facts or assumptions that are essential to a main thesis or to the argument in support of that thesis, to distinguish cause-effect relationships from other sequential relationships, and to recognize a writer's viewpoint.

   Synthesis is the production of a unique communication. It is the ability to propose ways of testing hypotheses, the ability to design an experiment, to formulate and modify hypotheses, and to make generalizations.

   Evaluation is defined as making judgments about the value of ideas, solutions, and methods. It involves the use of criteria to appraise the extent to which details are accurate, effective, economical, or satisfying. Evaluation includes the ability to apply given criteria to judgments of work done, to indicate logical fallacies in arguments, and to compare major theories and generalizations.